GPM for Understanding Convective Systems

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University of Utah
+ many, many colleagues

Acknowledgements

- Research Associate: Chuntao Liu (U of Utah)

Current and Former Students:

- Haiyan Jiang (now GSFC/UMBC)
- Yaping Li (U of Utah)
- Dave Yorty (U of Utah, now modifying the weather)
- Steve Nesbitt (Texas A&M and U of Utah, CSU, now U. of Illinois),
- Dan Cecil (Texas A&M, now NASA MSFC/UAH)
- Rick Toracinta (Texas A&M, Ohio State U; deceased)
- Karen Mohr (Texas A&M, now State U of NY at Albany)
- Chris Lucas (Texas A&M, now BMRC Australia)
- Gary McGaughey (Texas A&M, now Texas NRCC)

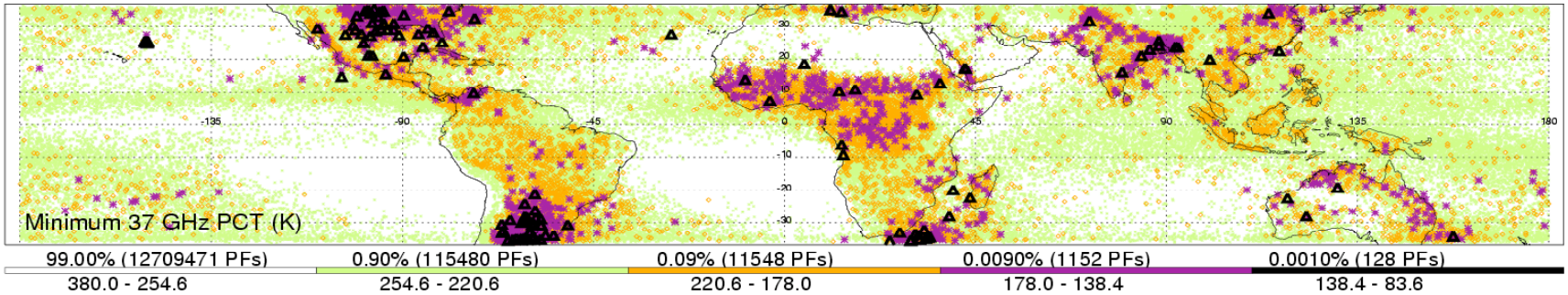
Robbie Hood, G. Heymsfield, +colleagues in numerous field programs

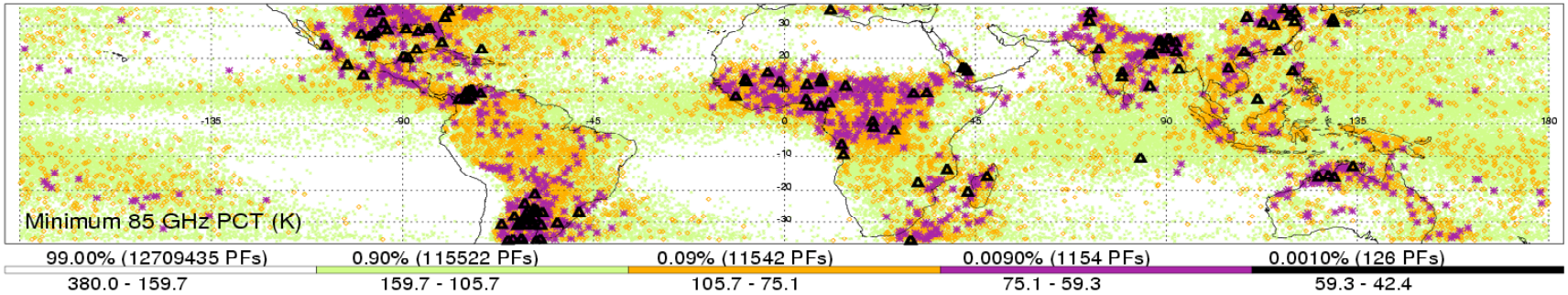
TRMM Prog. Scientists: Joanne Simpson, Chris Kummerow, Bob Adler

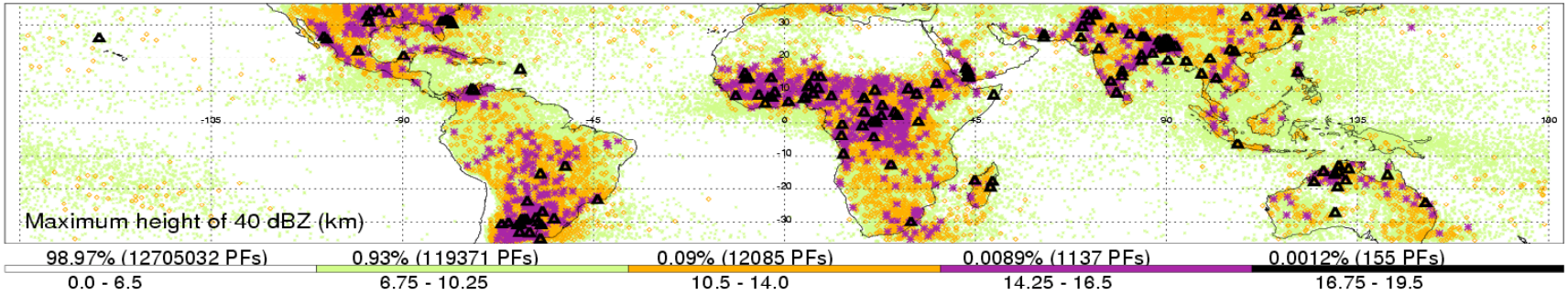
Erich Stocker and TSDIS

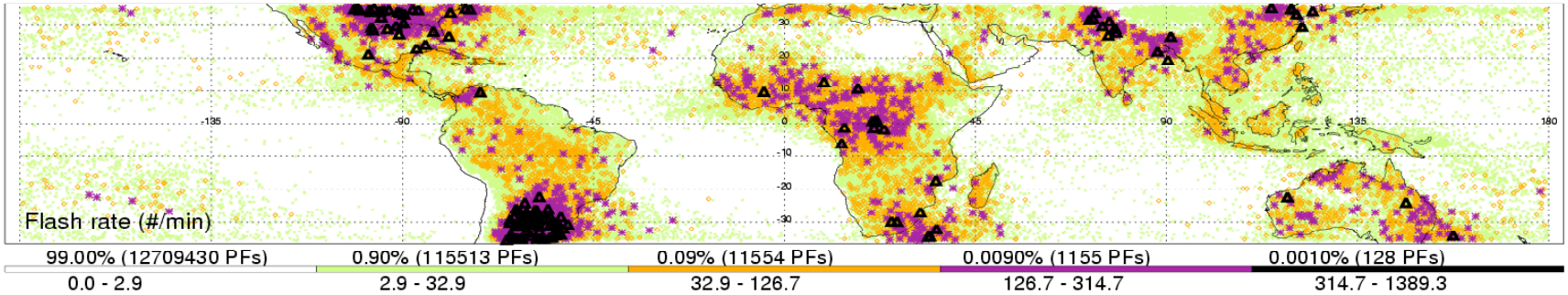
Funding: NASA TRMM Science and Earth System Science Fellowships

Intense convection using 4 quasi-independent proxies from 8 years of TRMM data (after Zipser et al. BAMS Aug 06)

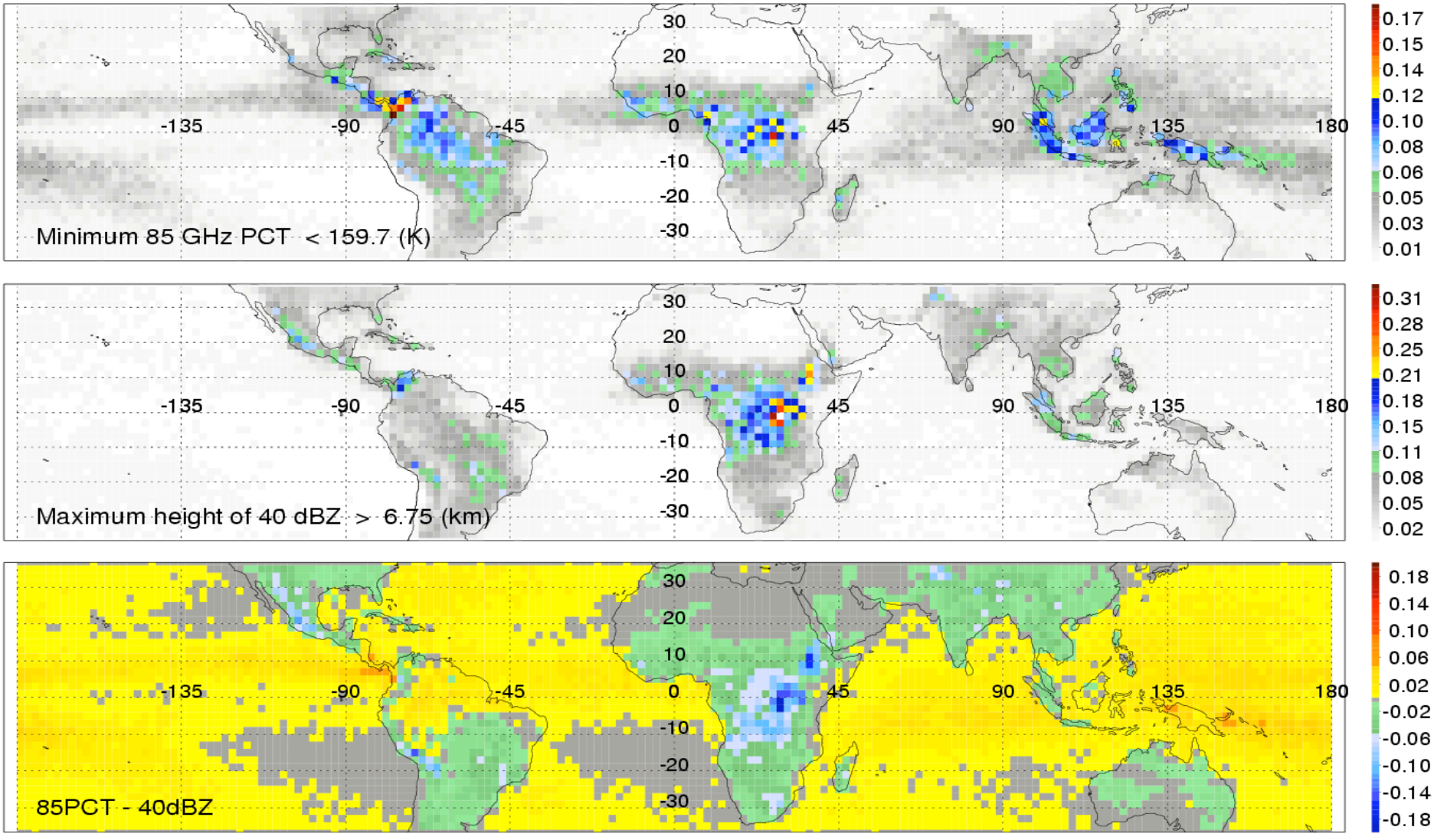




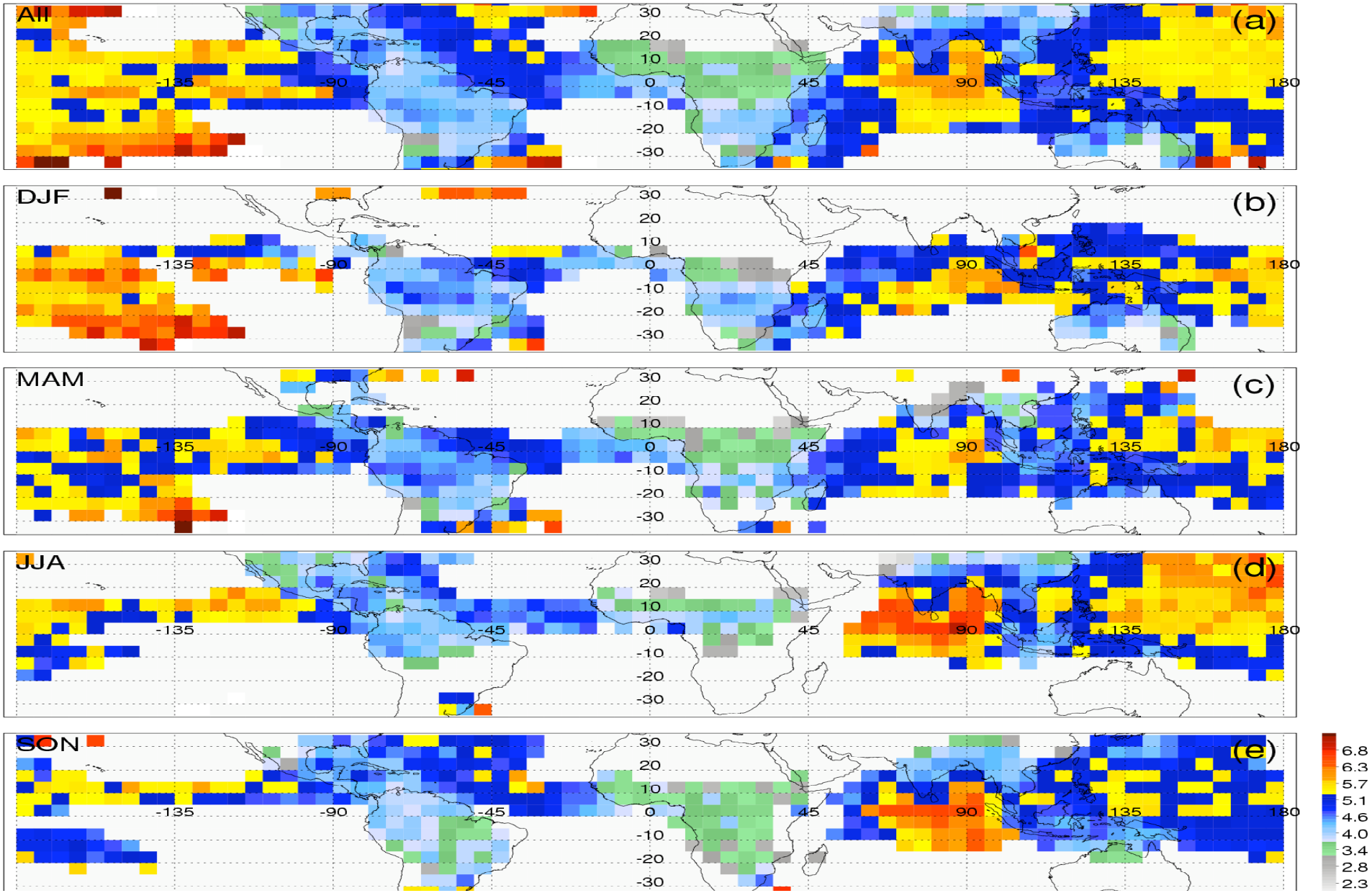




Intense convection proxies are indeed concentrated over land, but careful comparison shows that the Amazon and Africa meet different proxies more frequently. Do we understand why? Is this more evidence for “green ocean”?

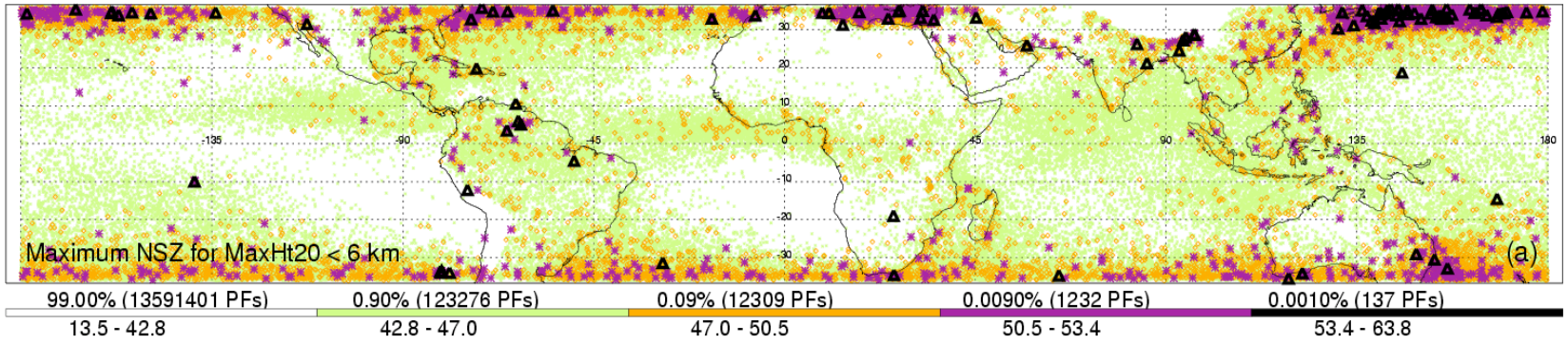


How much higher is IR cloud top than 20 dBZ radar top?
Hypothesis: The closer they are, the more intense the storm.
New Opportunity: Use CloudSat to probe the IR top - PR-top gap as f (regime)!

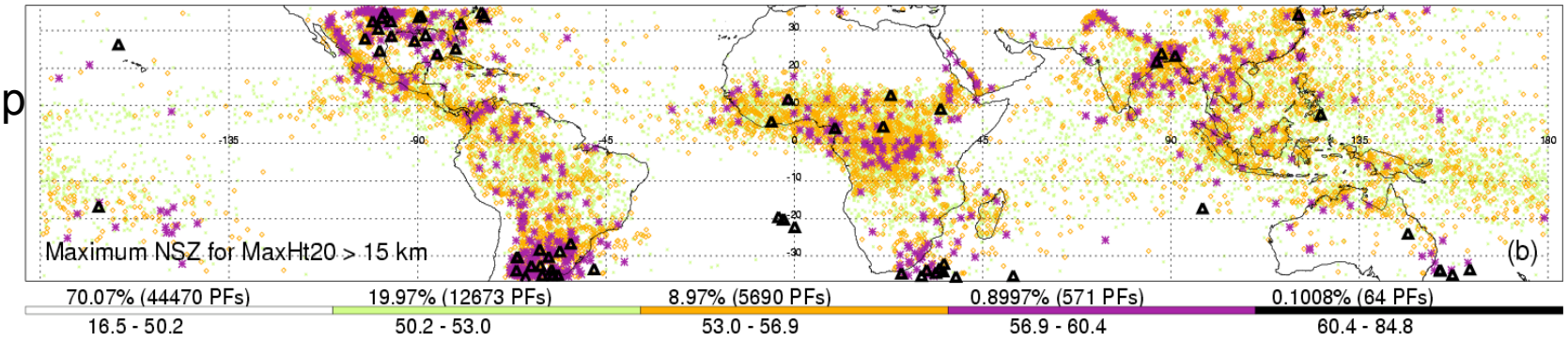


Where are the shallow (< 6 km) and deep (>14 km) storms with the greatest NSZ (near-surface reflectivity)

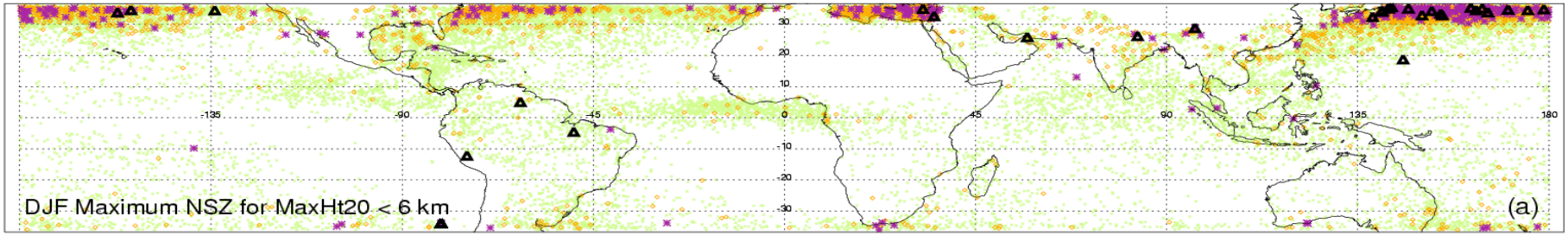
ECHO top
< 6 km

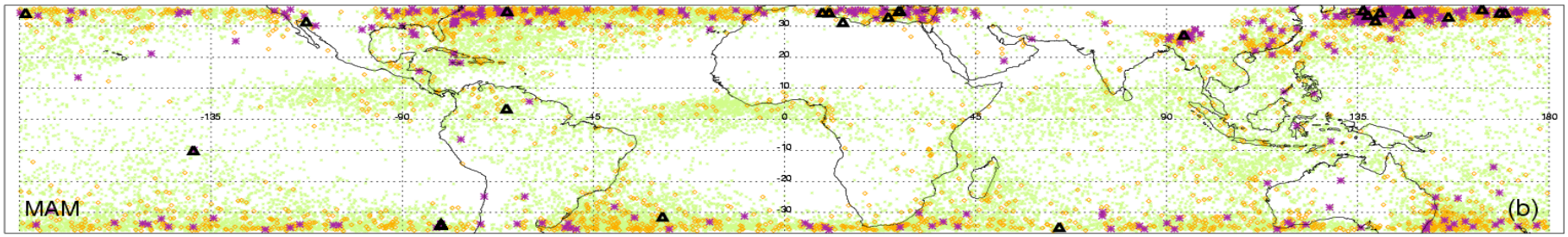


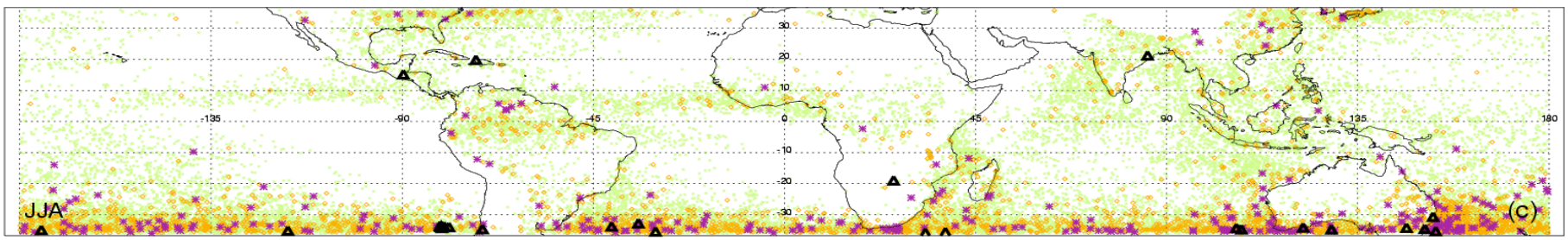
ECHO top
> 14 km

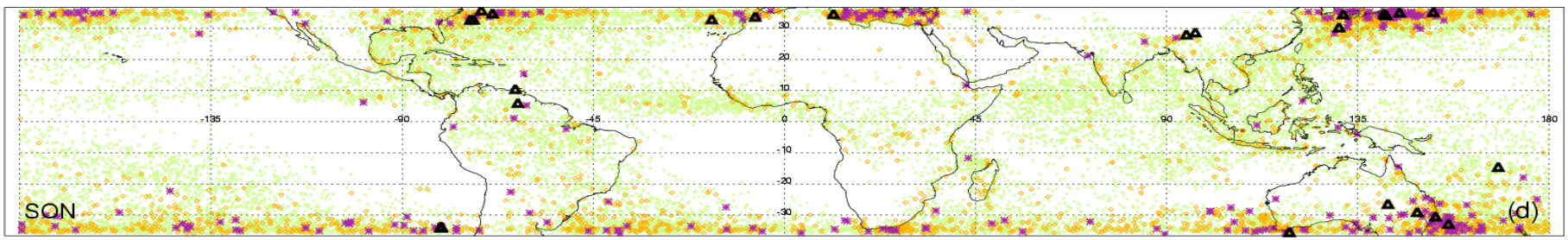


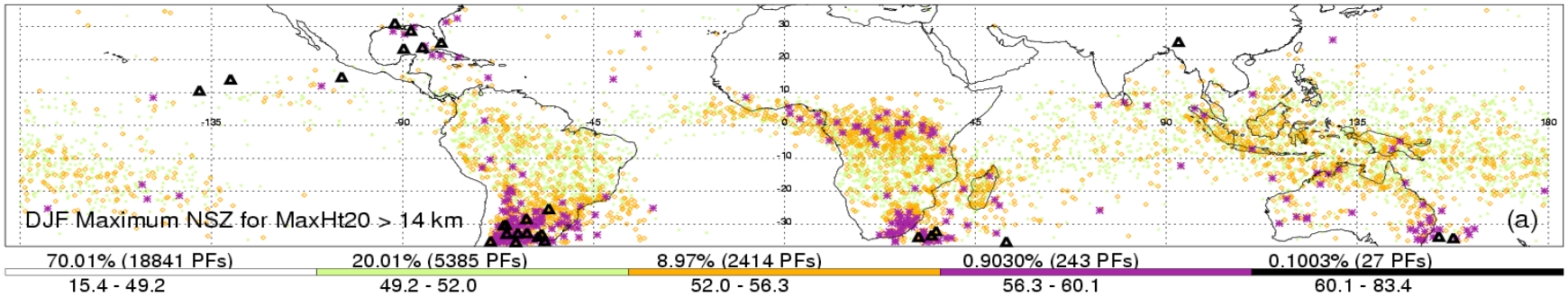
Next 2 slides gives their seasonal distribution:
Deep clouds have greater NSZ in summer; shallow clouds in winter

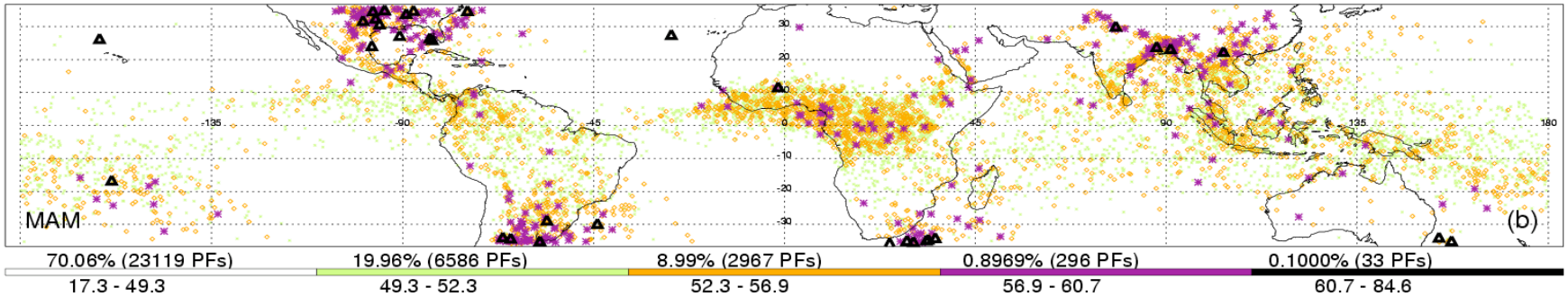

DJF Maximum NSZ for MaxHt20 < 6 km
(a)
99.00% (3387156 PFs)
0.90% (30688 PFs)
0.09% (3065 PFs)
0.0090% (308 PFs)
0.0010% (35 PFs)
13.5 - 43.4
43.4 - 47.9
47.9 - 51.4
51.4 - 54.1
54.1 - 62.8

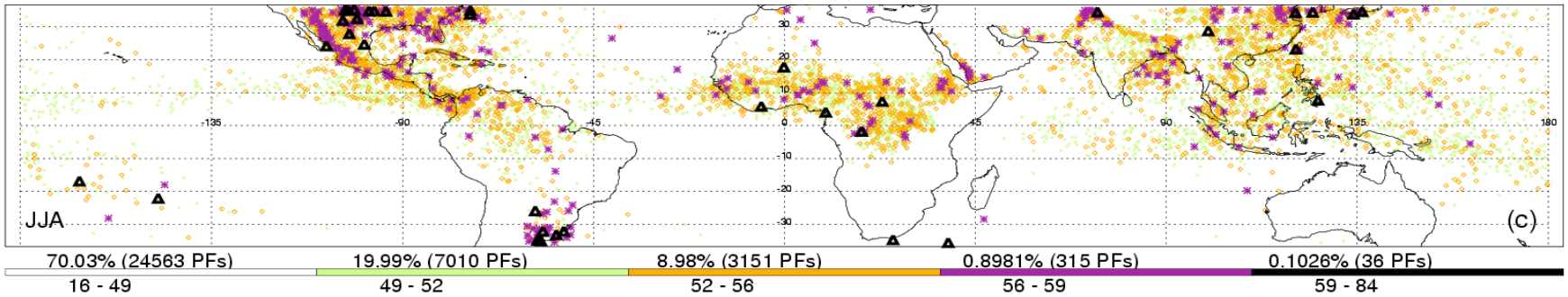

MAM
(b)
99.00% (3434914 PFs)
0.90% (31086 PFs)
0.09% (3100 PFs)
0.0090% (312 PFs)
0.0010% (34 PFs)
13.8 - 42.6
42.6 - 46.6
46.6 - 50.2
50.2 - 53.7
53.7 - 60.7

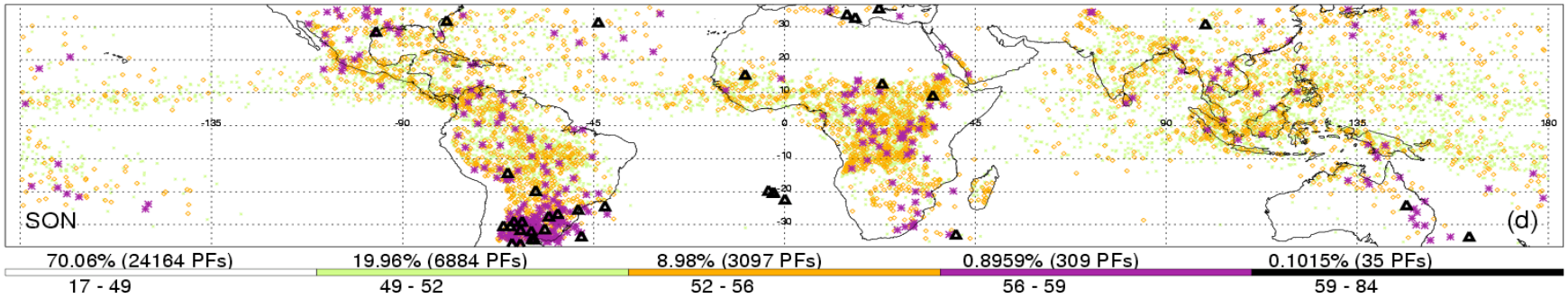

JJA
(c)
99.00% (3517546 PFs)
0.90% (31924 PFs)
0.09% (3199 PFs)
0.0089% (316 PFs)
0.0010% (36 PFs)
13 - 42
42 - 46
46 - 49
49 - 52
52 - 61


SON
(d)
99.00% (3251795 PFs)
0.90% (29562 PFs)
0.09% (2950 PFs)
0.0090% (296 PFs)
0.0010% (33 PFs)
13 - 42
42 - 46
46 - 49
49 - 53
53 - 63


DJF Maximum NSZ for MaxHt20 > 14 km
(a)
70.01% (18841 PFs)
20.01% (5385 PFs)
8.97% (2414 PFs)
0.9030% (243 PFs)
0.1003% (27 PFs)
15.4 - 49.2
49.2 - 52.0
52.0 - 56.3
56.3 - 60.1
60.1 - 83.4

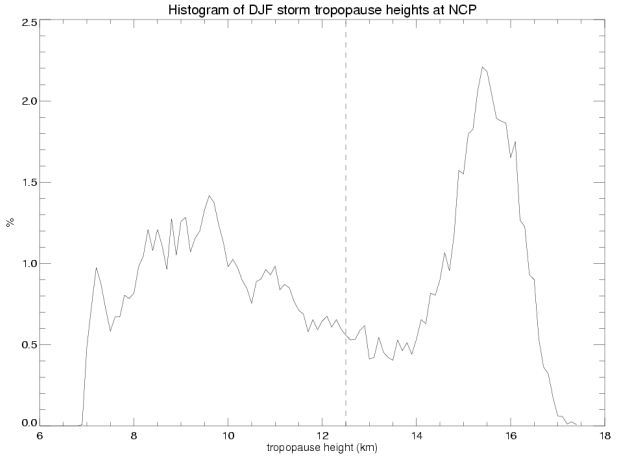

MAM
(b)
70.06% (23119 PFs)
19.96% (6586 PFs)
8.99% (2967 PFs)
0.8969% (296 PFs)
0.1000% (33 PFs)
17.3 - 49.3
49.3 - 52.3
52.3 - 56.9
56.9 - 60.7
60.7 - 84.6

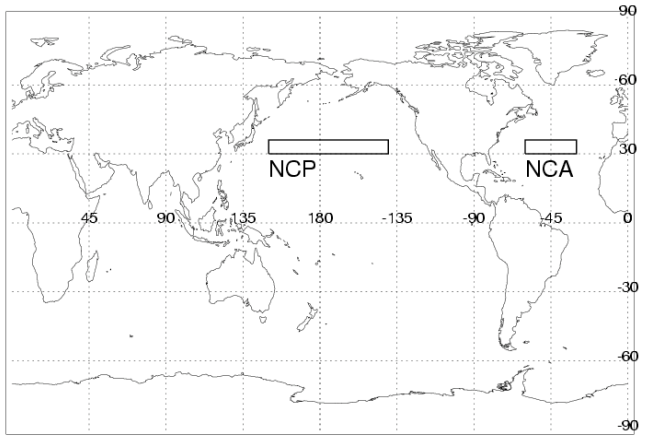

JJA
(c)
70.03% (24563 PFs)
19.99% (7010 PFs)
8.98% (3151 PFs)
0.8981% (315 PFs)
0.1026% (36 PFs)
16 - 49
49 - 52
52 - 56
56 - 59
59 - 84

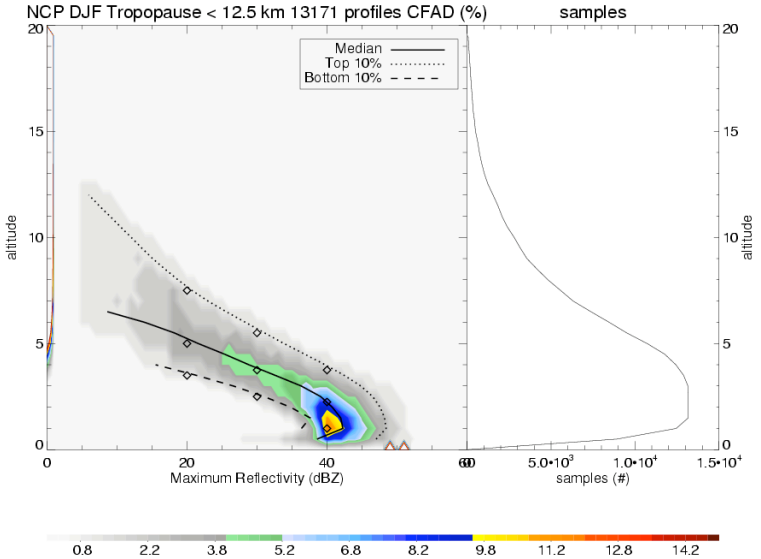

SON
(d)
70.06% (24164 PFs)
19.96% (6884 PFs)
8.98% (3097 PFs)
0.8959% (309 PFs)
0.1015% (35 PFs)
17 - 49
49 - 52
52 - 56
56 - 59
59 - 84

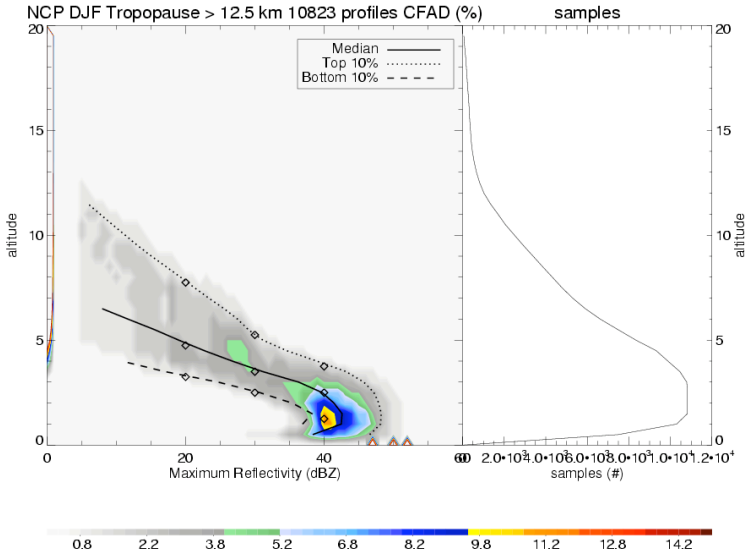
Using TRMM (+) to prepare for GPM in higher latitudes

- There is much we can learn about cold regimes
- Winter oceanic regimes can have very high near-sfc dBZ (next)





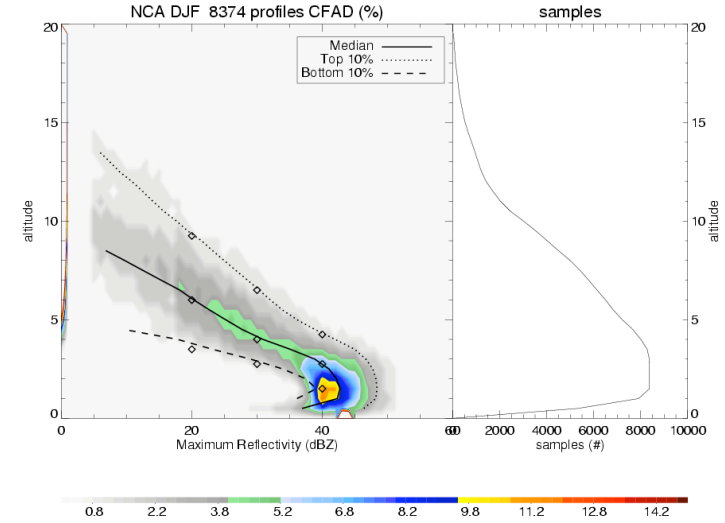


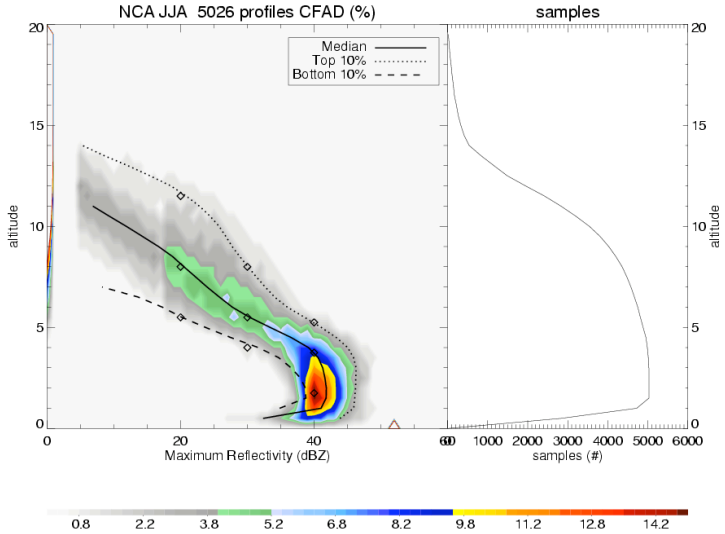


Winter profiles shallower than summer, ***but*** statistics of near-surface dBZ are similar

Extrapolate to subarctic conditions? Priority for field studies?

NC Atlantic (30N-36N, 30W-60W)

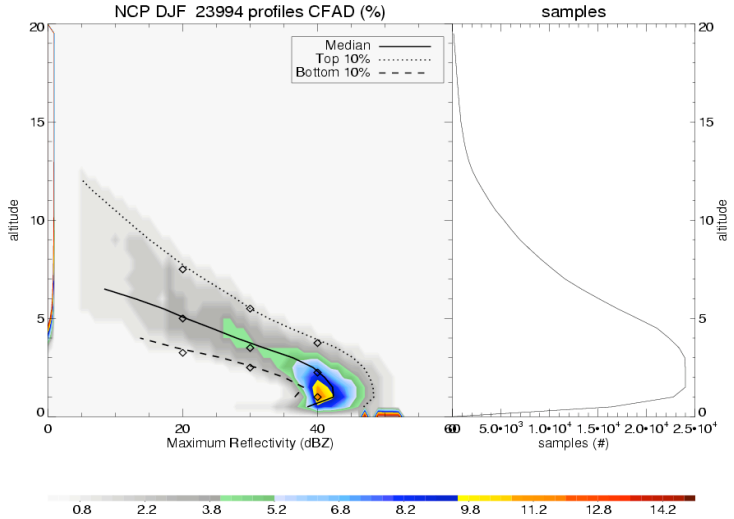


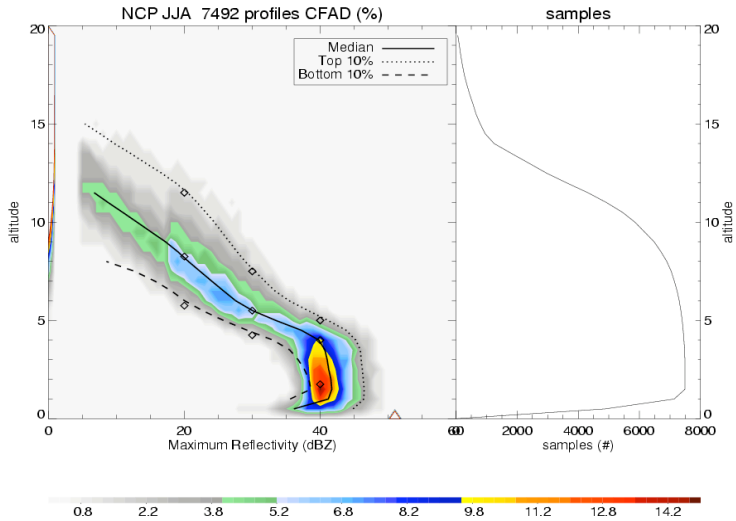


DJF

JJA

NC Pacific (30N-36N, 150E-140W)





From TRMM => GPM:

Transition activities for better understanding and retrievals of convective systems

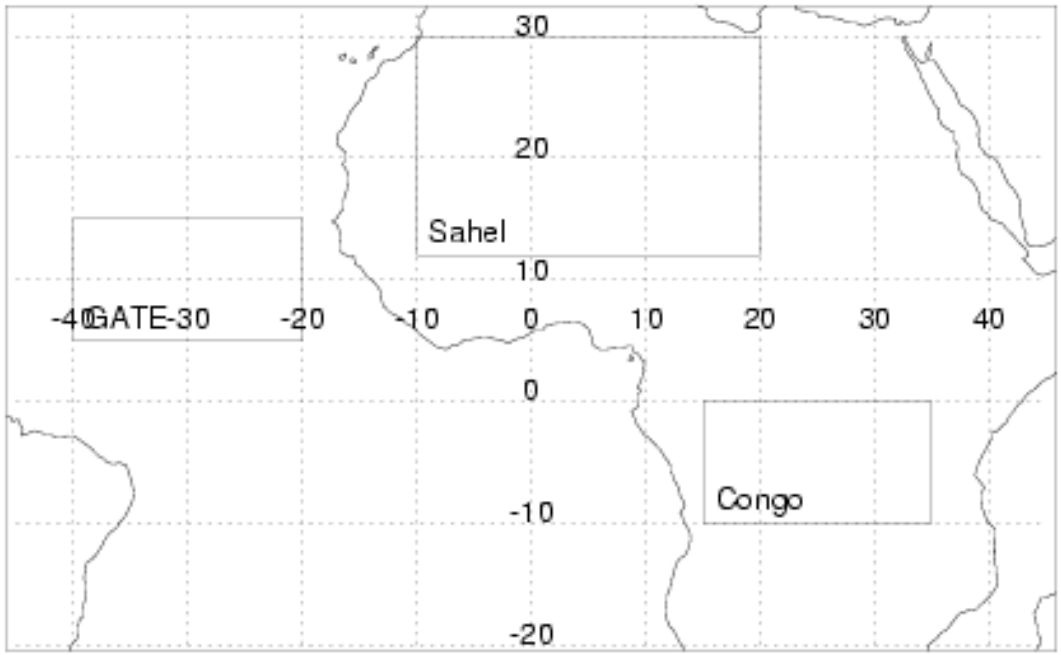
- *Exploit the TRMM legacy- compare statistics from different locations, regimes, seasons, ask WHY they differ, advance fundamental knowledge*
- *Use TRMM knowledge in cold regimes to ask better high latitude questions, use field campaign data, CloudSat data, ….., to improve retrievals*
- *Seek explanations NOW for PR/TMI differences*

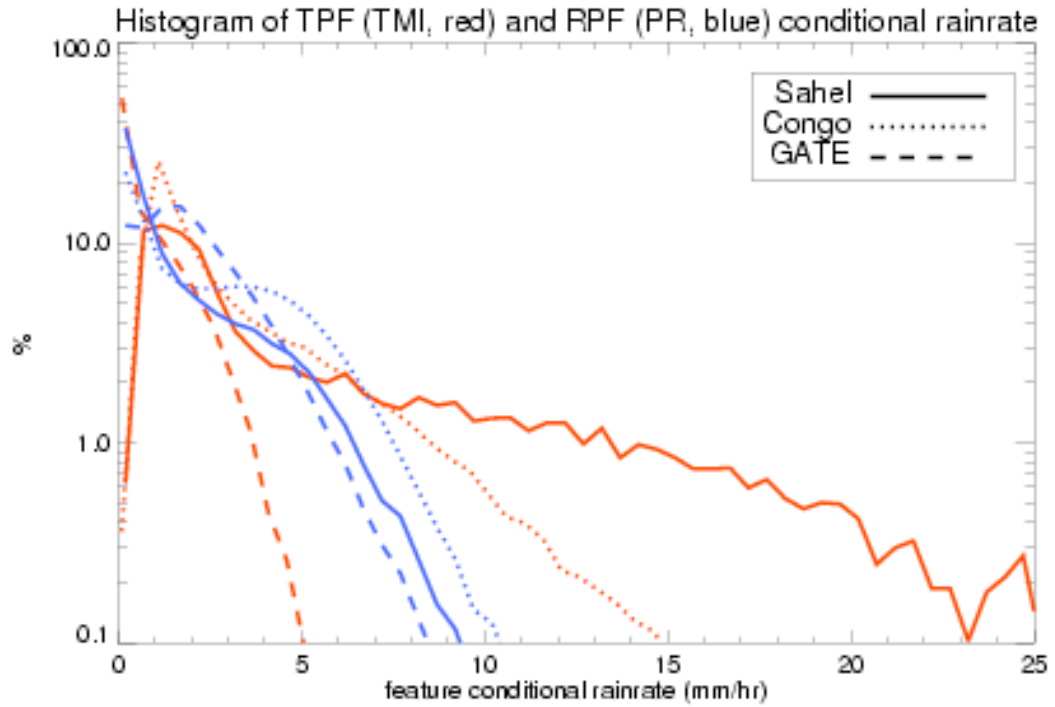
2A12 artifacts?

• PR (2A25) shows relatively small differences in conditional rain rate between these 3 regions.

• Due to the different land and ocean algorithms, TMI (2A12) retrievals have very different behaviors over land and ocean

• Sahel and Sahara have some cases with extremely high mean conditional rain rate values - a clear sign that retrievals over land need a lot of work

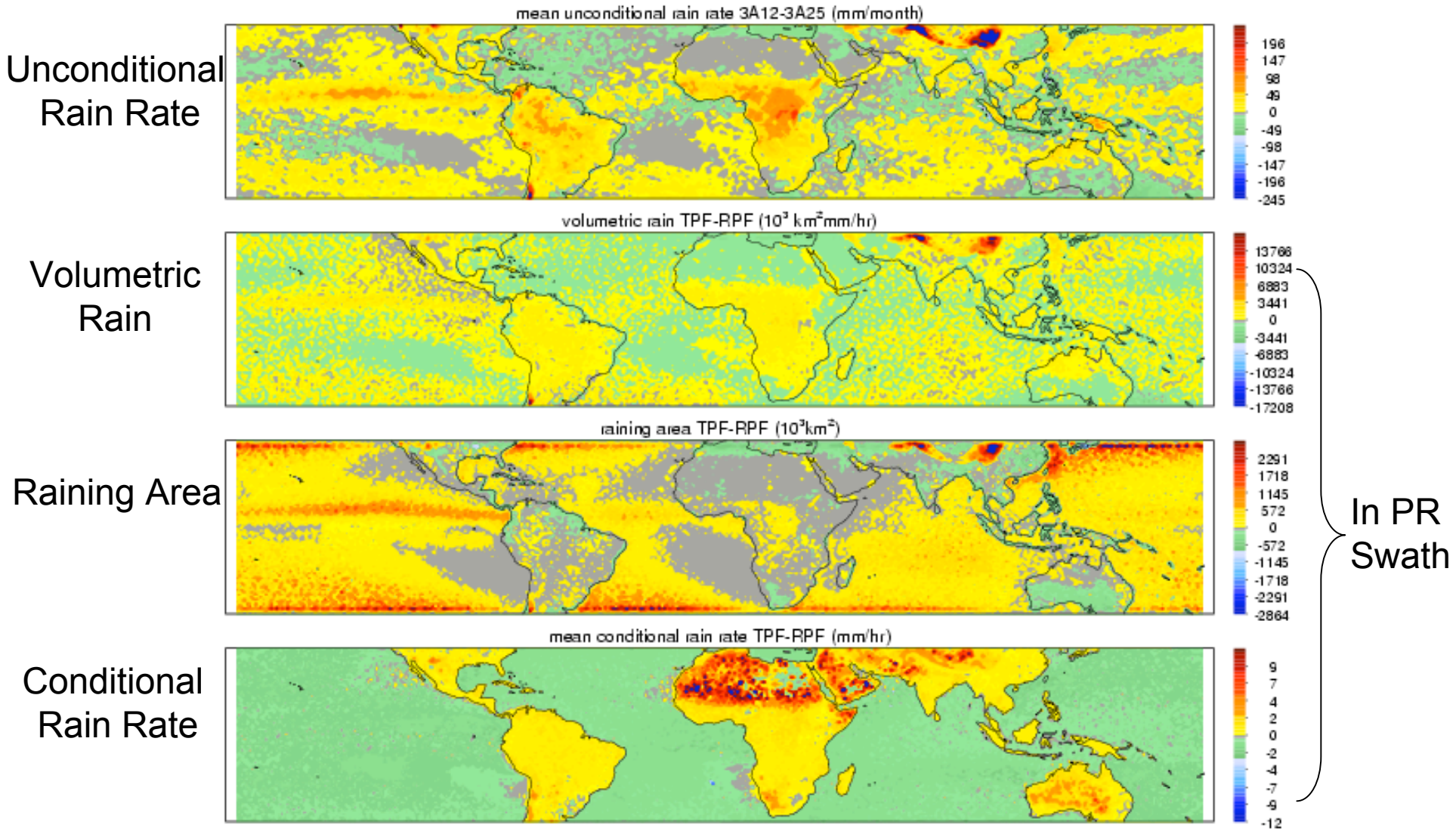




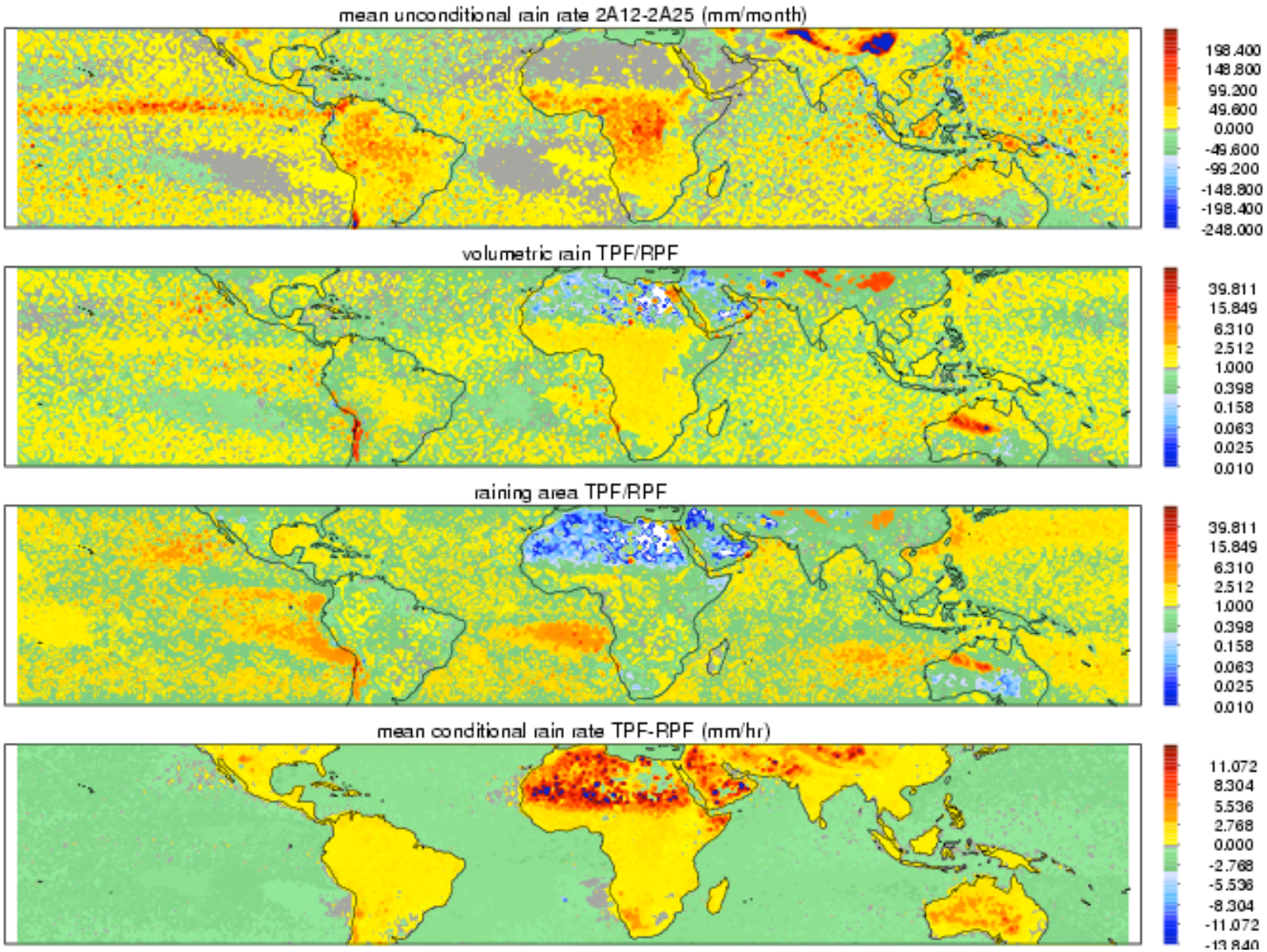
TMI - PR

What is the reason for the huge TMI rain rates over deserts?

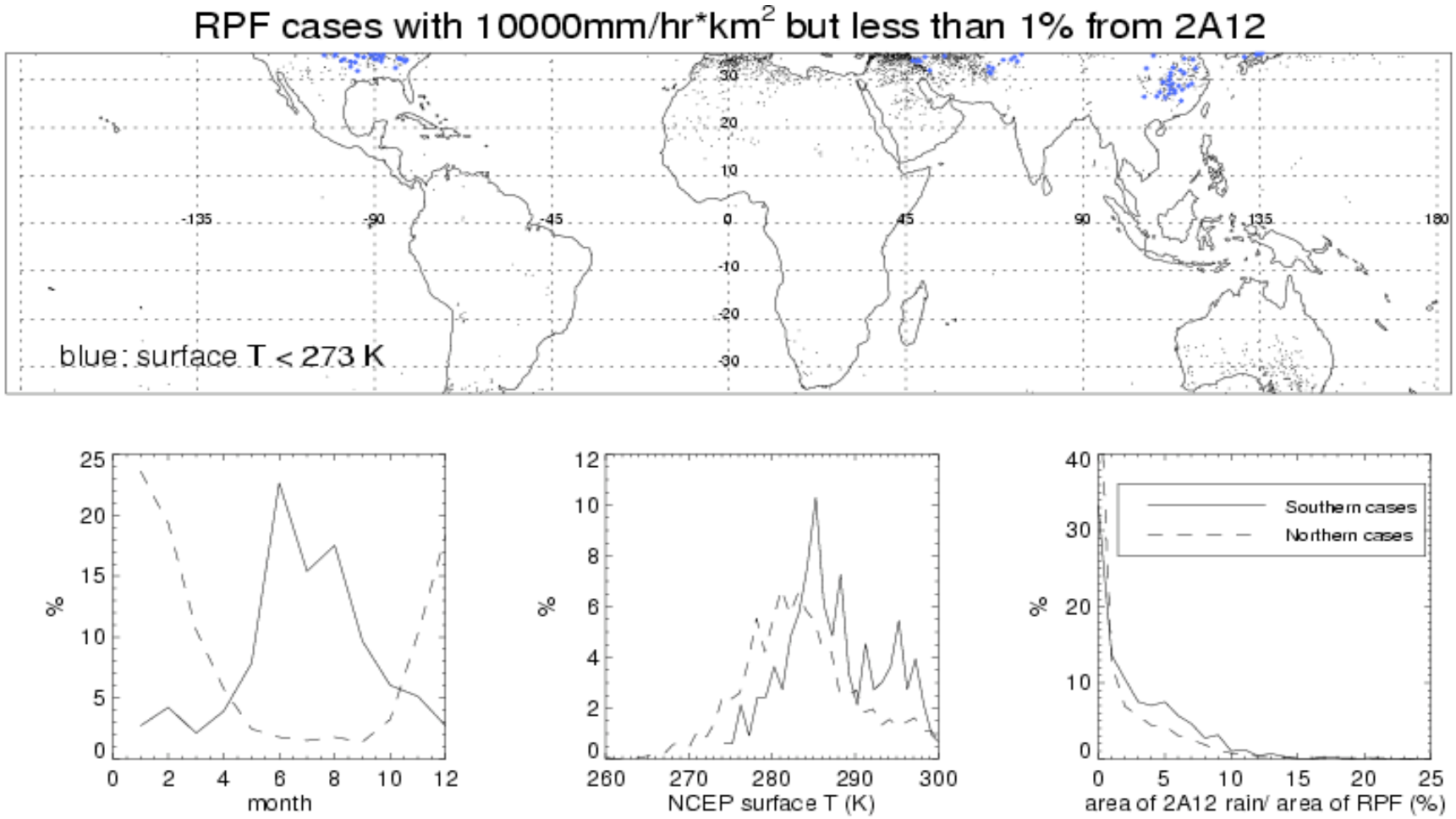
Answer: Too small raining area



TMI - PR (TMI/PR- middle 2 panels)

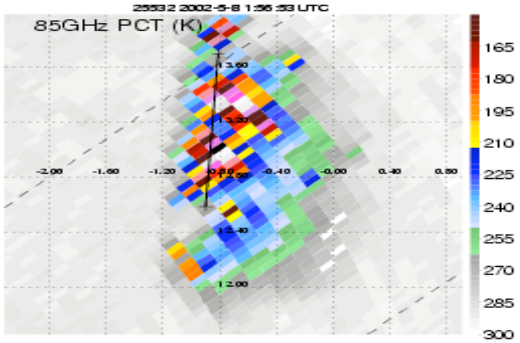


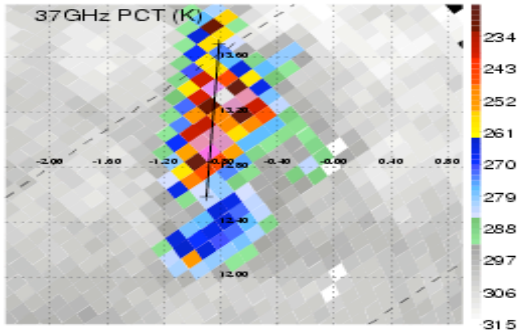
When/where does TMI miss the precipitation completely? Why? One example: Blue features are mostly snowstorms!

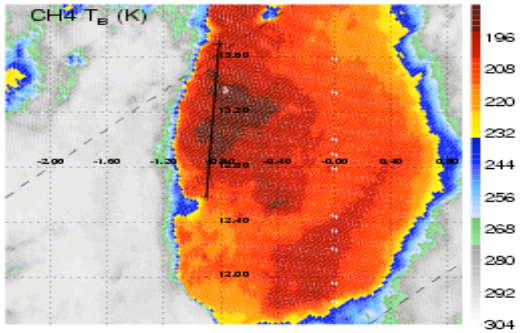


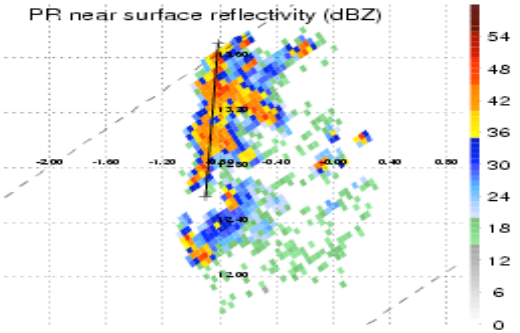
(extras)

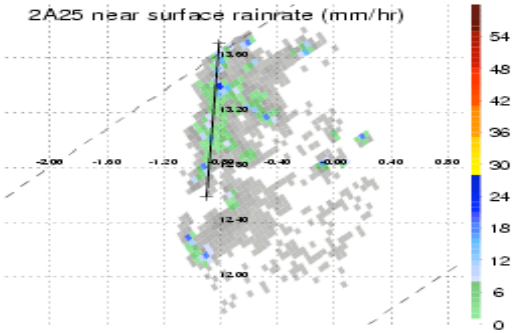
A Sahel case I (horizontal structure)

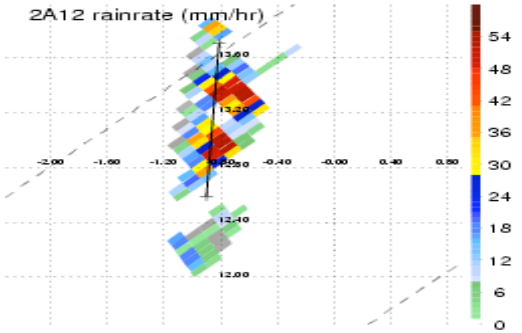


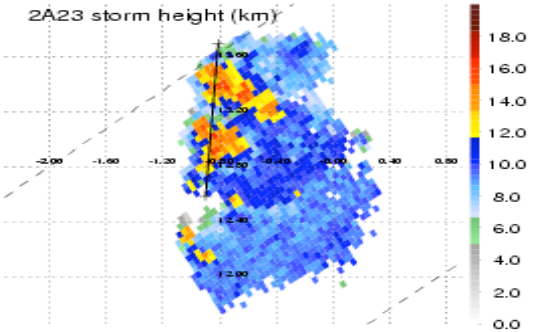


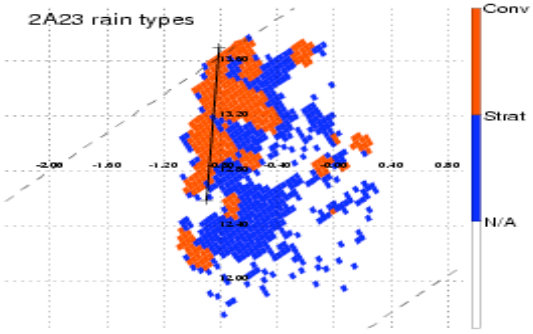








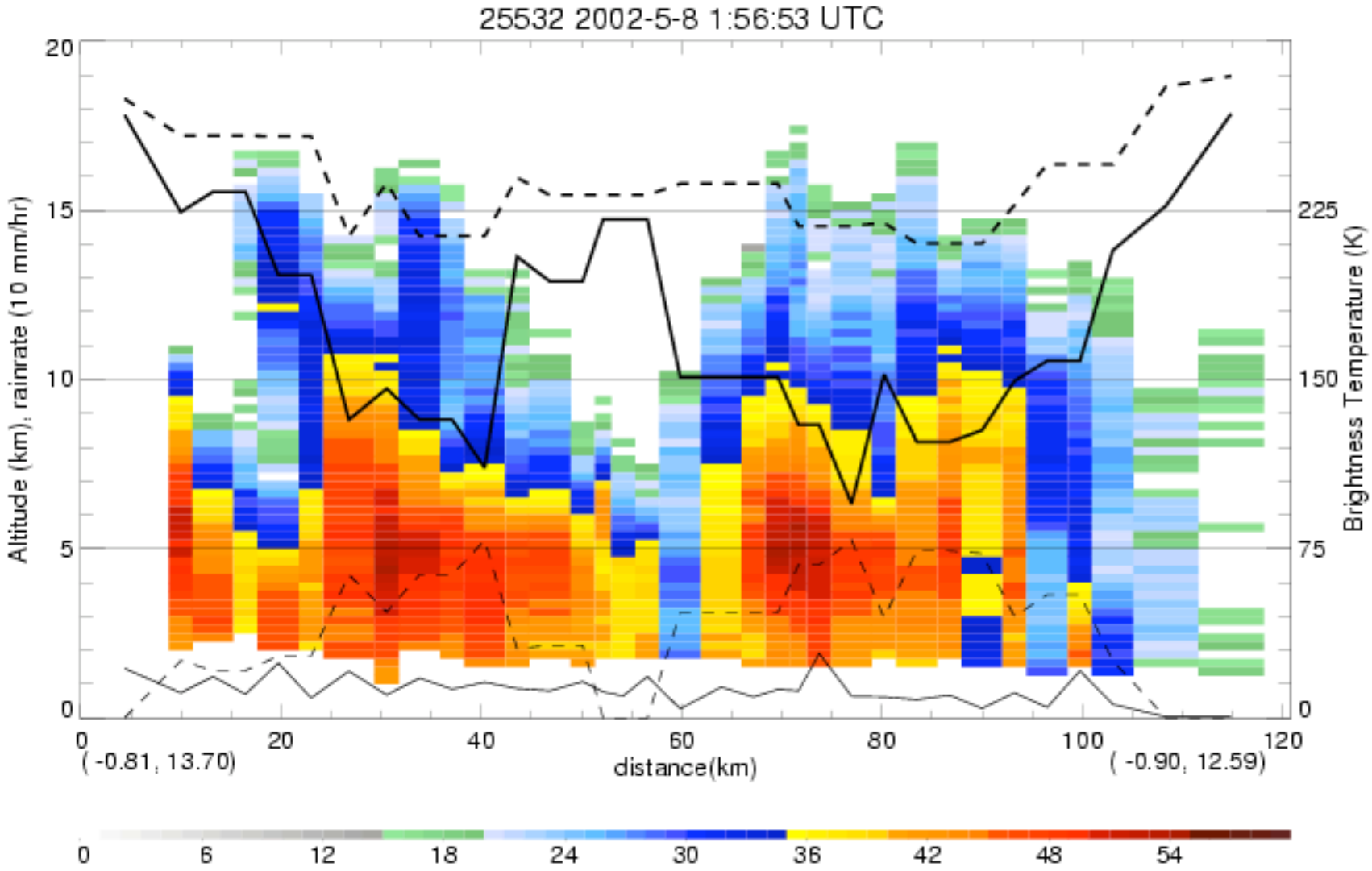




2A25 has very low rain rate comparing with 2A12

2A12 missed large raining area

A Sahel Case II
(Vertical cross section)



Unconditional rain rate

PIXEL LEVEL

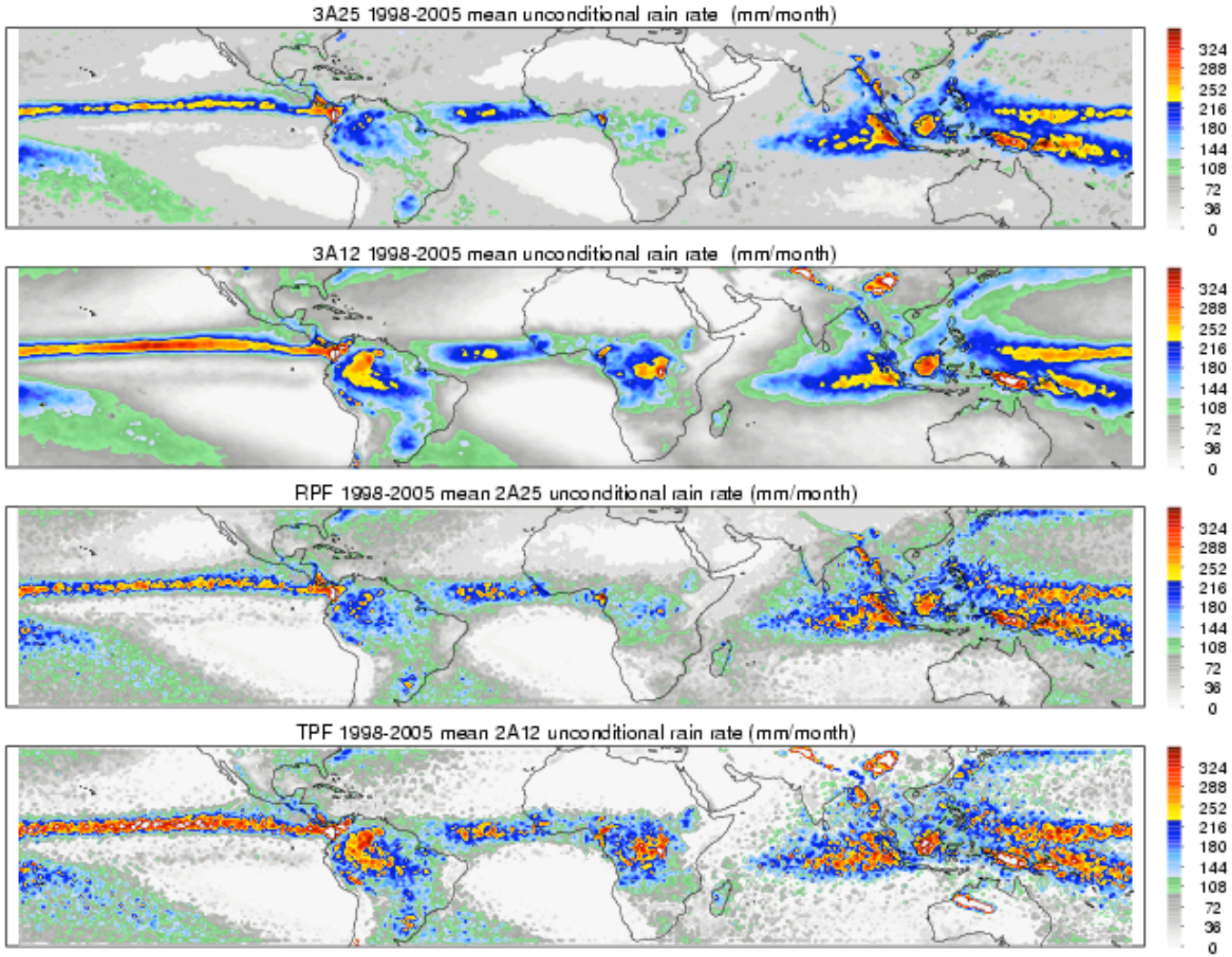
3A25

3A12

Precipitation feature level

RPF (2A25)

TPF (2A12)



PR

TMI

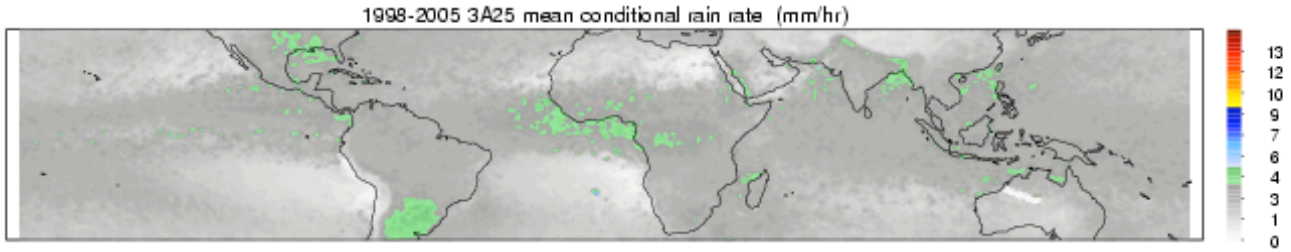
PR

TMI

Conditional rain rate

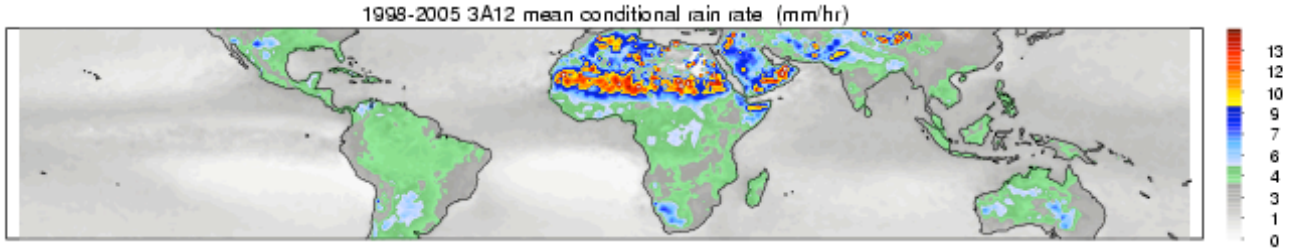
Pixel level

3A25



PR

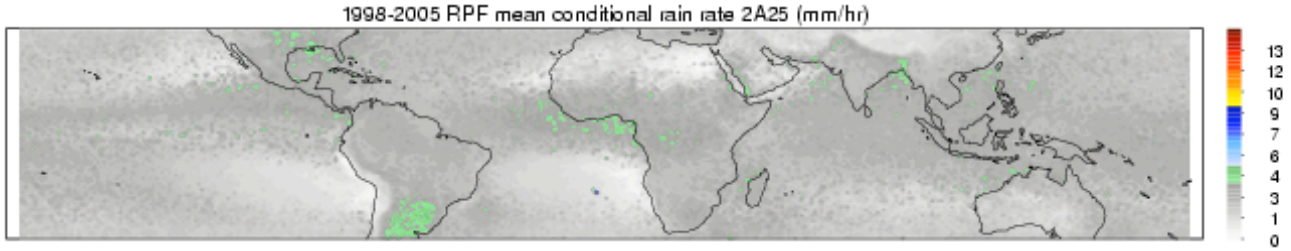
3A12



TMI

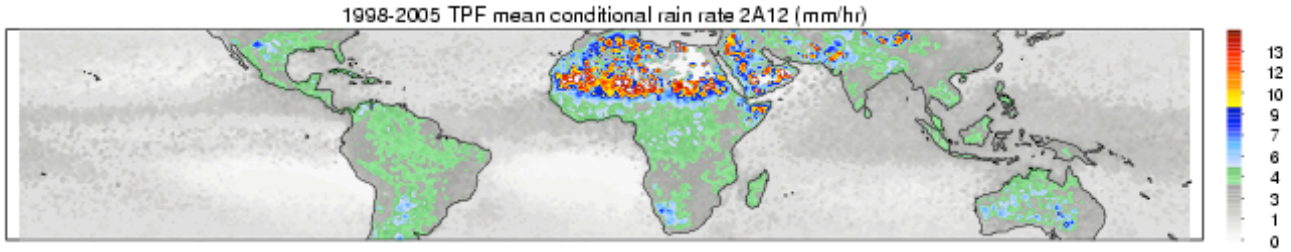
Precipitation Feature level

RPF (2A25)



PR

TPF (2A12)



TMI

Volumetric rain and raining area